Rec'd PCT/PTO 11 DEC 2001
09/936040

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Ichio YUDASAKA et al.

Application No.: 09/936,040

Filed: September 7, 2001 Docket No.: 110554

For: SYSTEM AND METHODS FOR MANUFACTURING A THIN FILM TRANSISTOR (AS AMENDED)

SUPPLEMENTAL PRELIMINARY AMENDMENT

Director of the U.S. Patent and Trademark Office
Washington, D. C. 20231

Sir:

Further to the Preliminary Amendment filed on September 7, 2001, and prior to initial examination, please amend the above-identified application as follows:

IN THE DRAWINGS:

Please amend Figures 2(D), 3(E), 5(E), 6(D), 10(D), 14(D), 16(E) and 18 as set forth in red in the attached Request for Approval of Drawing Corrections.

IN THE TITLE:

Please replace the title as follows:

SYSTEM AND METHODS FOR MANUFACTURING A THIN FILM TRANSISTOR

IN THE ABSTRACT:

Please replace the Abstract filed with the attached Abstract hereto.

IN THE SPECIFICATION:

Please replace the specification with the substitute specification attached hereto.

IN THE CLAIMS:

Please replace claims 1-12 as follows:

1. (Amended) A thin film transistor, comprising:

a gate electrode having a gate insulation film;

channel regions that extend through the gate insulation film in the gate electrode; and

source drain regions connected to said channel regions that are formed against a semiconductor film that is formed on the surface of an insulation substrate, wherein recombination centers which capture carriers are formed in said channel regions by part of crystal semiconductor films having a relatively low degree of crystallization among crystal semiconductor films that form said channel regions.

2. (Amended) The thin film transistor of Claim 1, wherein said recombination centers are concentrated adjacent to said drain regions within said channel regions.

3. (Amended) The thin film transistor of Claim 2, wherein said recombination centers are concentrated in a region, among channel regions, whose distance from the drain regions is equivalent to 1/3 to 1/10 of a channel length.

4. (Twice Amended) The thin film transistor according to Claim 1, wherein regions, among said channel regions, in which said recombination centers are concentrated have different film thickness compared to other regions.

5. (Twice Amended) The thin film transistor according to Claim 1, wherein regions, among said channel regions, in which said recombination centers are concentrated have different surface positions compared to other regions.

6. (Amended) The thin film transistor of Claim 5, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different surface height positions compared to other regions due to a different thickness of the semiconductor films forming said channel regions.

7. (Amended) The thin film transistor of Claim 5, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different surface height positions compared to other regions due to the formation of at least one of indented sections and bulged sections in a lower layer of the semiconductor films forming said channel regions.

8. (Amended) A method for manufacturing a thin film transistor comprising a gate electrode having a gate insulation film, channel regions that extend through a gate insulation film in the gate electrode, and source drain regions connected to said channel regions that are formed against a semiconductor film being formed on a surface of an insulation substrate, wherein a section having a relatively low degree of crystallization is formed within a predetermined region of said semiconductor films by applying laser annealing to said semiconductor films after forming the semiconductor films that form said channel regions.

9. (Amended) The method for manufacturing a thin film transistor according to Claim 8, wherein a section with a relatively low degree of crystallization is formed in the predetermined regions of said semiconductor film by applying said laser annealing to said semiconductor film after forming the semiconductor films with partially different film thickness as semiconductor films that form said channel regions.

10. (Amended) The method for manufacturing a thin film transistor according to Claim 8, wherein a section with a relatively low degree of crystallization is formed in the predetermined regions to said semiconductor film by applying said laser annealing for said semiconductor film after forming the semiconductor films with different surface height positions as semiconductor films that form said channel regions.

11. (Amended) The method for manufacturing a thin film transistor according to Claim 10, wherein the thickness of said semiconductor film is made to be different partially in forming said semiconductor film with different surface height positions.

12. (Amended) The method for manufacturing a thin film transistor according to Claim 11, wherein at least one of an indented section and a bulging section is formed beforehand in a lower layer of said semiconductor films in forming said semiconductor films with different surface height positions.

Please add new claims 17 and 18 as follows:

--17. A display device having a thin film transistor, the thin film transistor comprising:

a gate electrode having a gate insulation film;

channel regions that extend through the gate insulation film in the gate electrode; and

source drain regions connected to said channel regions that are formed against a semiconductor film that is formed on the surface of an insulation substrate, wherein recombination centers which capture carriers are formed in said channel regions by part of crystal semiconductor films having a relatively low degree of crystallization among crystal semiconductor films that form said channel regions.--

--18. A method for manufacturing a display device having a thin-film transistor, the thin-film transistor comprising a:

gate electrode having a gate insulation film, channel regions that extend through a gate insulation film in the gate electrode, and source drain regions connected to said channel regions that are formed against a semiconductor film being formed on a surface of an insulation substrate, wherein a section having a relatively low degree of crystallization is formed within a predetermined region of said semiconductor films by applying laser annealing to said semiconductor films after forming the semiconductor films that form said channel regions.--

REMARKS

Claims 1-18 are pending this application. By this Preliminary Amendment, the title, drawings, Abstract, specification and claims 1-12 are amended. Claims 17 and 18 are added. No new matter is added.

The attached Appendix includes marked-up copies of the substitute specification (37 C.F.R. §1.125(b)(2)) and each rewritten claim (37 C.F.R. §1.121(c)(1)(ii)).

Should the Examiner believe that anything further would be desirable in order to place this application in better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

John S. Kern
Registration No. 42,719

JAO:JSK/kap

Attachment:
Appendix

Date: December 11, 2001

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ABSTRACT

The present invention provides a thin film transistor (TFT) and its production method which enable the stabilizing of saturation current and improving reliability by improving the film quality of the channel region. The TFT includes a channel region towering over a gate electrode through a gate insulation film, a source region connecting to the channel region and a drain region connecting to the channel region on an opposite side of the source region are formed on the polycrystal semiconductor film on which island-like patterning is performed. An indented section is formed on a surface of the channel region, and the section corresponding to the indented section becomes a recombination center which captures the small-number carrier (holes) because the degree of the crystallization is low in the section corresponding to the indented section due to shift from the optimum conditions at the time of laser annealing of the semiconductor.

APPENDIX

Changes to Title:

The following is a marked-up version of the amended title:

SYSTEM AND METHODS FOR MANUFACTURING A THIN FILM TRANSISTOR~~A Thin Film Transistor and A method for manufacturing thereof~~

Changes to Abstract:

The following is a marked-up version of the amended Abstract:

The present invention provides a thin film transistor (TFT) and its production method which enable the stabilizing of saturation current and improving reliability by improving the film quality of the channel region. ~~In TFT 10, the~~ The TFT includes a channel region ~~15~~ towering over ~~the~~ a gate electrode ~~14~~ through ~~the~~ a gate insulation film ~~12~~, ~~the~~ a source region ~~16~~ connecting to the channel ~~15~~ region and ~~the~~ a drain region ~~17~~ connecting to the channel region ~~15~~ on ~~the~~ an opposite side of the source region ~~16~~ are formed on the polycrystal semiconductor film ~~100~~ on which island-like patterning is performed. An indented section ~~155~~ is formed on ~~the~~ a surface of the channel region ~~15~~, and the section corresponding to the indented section ~~155~~ becomes ~~the~~ a recombination center ~~150~~ which captures the small-number carrier (holes) because the degree of the crystallization is low in the section corresponding to the indented section ~~155~~ due to shift from the optimum conditions at the time of laser annealing of the semiconductor ~~100~~. ~~Thus the invention provides a TFT and its production method which enable the stabilizing of saturation current and improving reliability by improving the film quality of the channel region.~~

A Substitute Specification is attached in accordance with 37 C.F.R. 1.125(b)(2).

Changes to Claims:

The following is a marked-up version of the amended claims 1-12:

1. (Amended) A thin film transistor, comprising:~~of the type wherein~~

a gate electrode having a gate insulation film;

channel regions ~~which tower~~ that extend through the gate insulation film in the gate electrode; and

source drain regions connected to said channel regions that are formed against a semiconductor film ~~being~~ that is formed on the surface of an insulation substrate, wherein recombination centers which capture carriers are formed in said channel regions by part of crystal semiconductor films ~~with~~having a relatively low degree of crystallization among crystal semiconductor films ~~forming~~ that form said channel regions.

2. (Amended) The thin film transistor of Claim 1, wherein said recombination centers are concentrated ~~in the vicinity of~~ adjacent to said drain regions ~~among~~ within said channel regions.

3. (Amended) The thin film transistor of Claim 2, wherein said recombination centers are concentrated in ~~the~~ a region, among channel regions, whose distance from the drain regions is equivalent to 1/3 to 1/10 of ~~the~~ a channel length.

4. (Twice Amended) The thin film transistor according to Claim 1, wherein ~~the~~ regions, among said channel regions, in which said recombination centers are concentrated have different film thickness compared to other regions.

5. (Twice Amended) The thin film transistor according to Claim 1, wherein ~~the~~ regions, among said channel regions, in which said recombination centers are concentrated have different surface positions compared to other regions.

6. (Amended) The thin film transistor of Claim 5, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different surface height positions compared to other regions due to a different thickness of the semiconductor films forming said channel regions.

7. (Amended) The thin film transistor of Claim 5, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different surface height positions compared to other regions due to the formation of at least one of indented sections ~~or~~ and bulged sections in ~~the~~ a lower layer of the semiconductor films forming said channel regions.

8. (Amended) A method for manufacturing a thin film transistor comprising a gate electrode having a gate insulation film, ~~wherein~~ channel regions ~~which tower~~ that extend through ~~the~~ a gate insulation film in the gate electrode, and source drain regions connected to said channel regions that are formed against a semiconductor film being formed on ~~the~~ a surface of an insulation substrate, wherein a section ~~with~~ having a relatively low degree of crystallization is formed within a predetermined region of said semiconductor films by applying laser annealing ~~for~~ to said semiconductor films after forming the semiconductor films ~~for forming~~ that form said channel regions.

9. (Amended) ~~A~~The method for manufacturing a thin film transistor according to Claim 8, wherein a section with a relatively low degree of crystallization is formed in the predetermined regions of said semiconductor film by applying said laser annealing ~~for~~ to said semiconductor film after forming the semiconductor films with partially different film thickness as semiconductor films ~~for forming~~ that form said channel regions.

10. (Amended) ~~A~~The method for manufacturing a thin film transistor according to Claim ~~9~~ 8, wherein a section with a relatively low degree of crystallization is formed in the predetermined regions ~~of~~ to said semiconductor film by applying said laser annealing for said semiconductor film after forming the semiconductor films with different surface height positions as semiconductor films ~~for forming~~ that form said channel regions.

11. (Amended) ~~A~~ The method for manufacturing a thin film transistor according to Claim 10, wherein the thickness of said semiconductor film is made to be different partially in forming said semiconductor film with different surface height positions.

12. (Amended) ~~A~~The method for manufacturing a thin film transistor according to Claim 11, wherein at least one of an indented section ~~or~~ and a bulging section is formed beforehand in ~~the~~ a lower layer of said semiconductor films in forming said semiconductor films with different surface height positions.

Claims 17 and 18 are added.

JC12 Rec'd PCT/PTO 07 SEP 2001
09/936040

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Ichio YUDASAKA, Mitsutoshi MIYASAKA,
Piero MIGLIORATO

Application No.: U.S. National Stage of PCT/GB01/00007

Filed: September 7, 2001 Docket No.: 110554

For: A THIN FILM TRANSISTOR AND A METHOD FOR MANUFACTURING THEREOF

PRELIMINARY AMENDMENT

Director of the U.S. Patent and Trademark Office
Washington, D. C. 20231

Sir:

Prior to initial examination, please amend the above-identified application as follows:

IN THE CLAIMS:

Please replace claims 4 and 5 as follows:

4. (Amended) The thin film transistor according to Claim 1, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different film thickness compared to other regions.

5. (Amended) The thin film transistor according to Claim 1, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different surface positions compared to other regions.

Please add new claims 13-16 as follows:

-- 13. The thin film transistor according to Claim 2, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different film thickness compared to other regions. --

-- 14. The thin film transistor according to Claim 3, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different film thickness compared to other regions. --

-- 15. The thin film transistor according to Claim 2, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different surface positions compared to other regions. --

-- 16. The thin film transistor according to Claim 3, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different surface positions compared to other regions. --

REMARKS

Claims 1-16 are pending. By this Preliminary Amendment, claims 4 and 5 are amended and claims 13-16 are added to eliminate multiple dependencies. Prompt and favorable examination on the merits is respectfully requested.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Eric D. Morehouse
Registration No. 38,565

JAO:EDM/cmm

Attachment:
Appendix

Date: September 7, 2001

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DEPOSIT ACCOUNT USE AUTHORIZATION
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APPENDIX

JC12 Rec'd PCT/PTO 07 SEP 2001

Changes to Claims:

Claims 13-16 are added.

The following are marked-up versions of the amended claims:

4. (Amended) The thin film transistor according to ~~any one of Claims 1 to Claim 3,~~ Claim 1, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different film thickness compared to other regions.

5. (Amended) The thin film transistor according to ~~any one of Claims 1 to Claim 3,~~ Claim 1, wherein the regions, among said channel regions, in which said recombination centers are concentrated have different surface positions compared to other regions.